What does it need to be a photon scientist?

February 11 is the International Day of Women and Girls in Science!! That`s why we asked your female scientists – from early career to established researcher – what their research is about, what impact it has on the field of photon science, what they think a photon scientist needs and if there is any advice they would like to give to future photon scientists. We thank Larissa, Daniela, Katharina and Elsa for their answers.

1. What is your research about and what impact does it have on the field of photon science?

Larissa: I am developing an experiment where we can use conventional infrared laser light to transform it into light of a much longer wavelength. We use specific non-linear processes in crystalline materials to get variable and controllable light in the micrometer wavelength range. This range is particularly interesting to understand processes in crystal lattices, as the wavelength range is in the same order as the lattice vibrations that we want to study. With my research, I am able to complement the current light sources by making a new wavelength range accessible to study properties in complex materials. This new source is very useful to understand how an atomic lattice behaves when a lot of energy is deposited into the lattice very quickly. You can also watch the video produced in the #NCCRWomen campaign.

Daniela: In our experiments we investigate short-lived nanostructures and ultrafast changes of their electronic and structural properties under laser excitation. One of the most important methods is single particle diffraction, which combines extreme spatial and temporal resolution. These experiments are possible because XUV and X-ray free-electron lasers and high-harmonic sources can provide sufficiently intense and ultrashort short-wavelength pulses to obtain a snapshot image within a single laser shot. The diffraction images contain information on the electron distribution in the nanoparticle, therefore not only the particle's shape, but also laser-induced changes in the structure and even in the electronic properties can be followed using pump-probe methods. The new endstation "Maloya" at PSI and the efforts at the SwissFEL to produce intense attopulses in the soft X-ray region will push our research to a new level - into the world of electron dynamics.

Katharina: I investigate superfluid helium droplets and their interaction with intense and short X-ray pulses (her video). With this work, we want to gain better insights into the dynamics of atomic and molecular clusters when they are irradiated with intense light, eventually paving the way to directly imaging them in free flight.

Elsa: I use ultrafast spectroscopy tools to study the dynamics of quantum materials. This means that we excite the sample with a short laser pulse and probe it with a second laser pulse, delayed in time with respect to the first, to make a "short movie" of the response of the system. Quantum materials are quite fascinating in that they display a variety of unique properties such as charge and magnetic order, superconductivity, insulator-to-metal transitions, etc. The combination of ultrafast spectroscopy and condensed matter has led to many developments in photon science, such as extending the range where ultrashort pulses are available into the terahertz and x-ray frequency ranges.

2. What qualities or skills do you think are necessary to become a photon scientist?

Photon science covers many fields of physics from optics, material and solid state science to atomic and molecular physics, this is also a plus, the photon approach brings those fields together. Thus, besides a Master's degree in Physics (or similar) you will need:

- Curiosity is the basis!!
- Being a team player makes the experiments most fun but also many of the experiments are too complex and time consuming, and require too wide a range of expertise, to be attempted alone..
- As well as keeping an open mind is also essential, since the solution to a specific problem or limitation may be found in the neighboring setup or laboratory, and may require some adaptation.
- Patience (because things rarely work out during the first trial) which means, endurance to repeat the same thing over and over in order to find errors and improve the setup is crucial.
- The willingness to work hands-on (if you hate screwdrivers, this job is not for you)! Because the photon science tools and techniques can be quite unique and in many cases require a significant amount of development and / or maintenance.

3. What have been the most influential steps for your career?

Daniela: First, when I looked for my diploma project, I visited several different groups, did small internships, seminars and so on, and ended up there where I liked the people best. For me this worked out! Second, I was lucky to be there when for the first time ever free-flying nanoparticles were imaged in single X-ray bursts with the first short-wavelength FEL FLASH in Hamburg in 2007. The diffraction-before-destruction concept fascinated me and the diffraction patterns were just so very beautiful but not understood at that point. I got hooked. And third, when I was asked to apply at ETH, the fact that it was an open topic search let me think about what I could do and would like to do instead of worrying how I would not fit.

Katharina: The most influential step was meeting my supervisor, when I started my bachelor thesis with her. Her excitement about the science we do is contagious - so I haven't left her group since then. The second most important point of my career so far has been the start of my doctorate at ETH Zurich; it is great to work in such a privileged and supporting scientific environment.

Elsa: That were the experience of moving abroad (Sweden, the US, Switzerland) - wonderful for personal and professional development. And the choice of my the group where I did my PhD (I had a good feeling about it at the start but of course was lucky that the good feeling was confirmed!) - it got me into this field of science and working with a great mentor.

Larissa: Starting a bachelor in Physics after school (and finishing my degree) and being confident enough to apply to a university where I don't know anybody who could tell me a bit about the environment, trusting in my skills.

4. Who are your role models and why?

Elsa: Three people I have worked with starting during my PhD. I won't name them but I will name their qualities: integrity in the technical and personal aspects of scientific work, great competence allied with a very healthy balance of confidence and humility, openness for discussion / dialogue / exchange, kindness and empathy, curiosity.

Larissa: In principle, any other women who has to overcome negative stereotypes in their work environment is a role model. It can be tiring to react to other people's judgement, and I value everyone who doesn't give up at that point. A specific role model is my former Master thesis supervisor, who is now a Postdoc at the synchrotron in Trieste. She is very honest about telling me what doubts she has in her career, she encourages me and supports me when I need advice. Although the career path for her is as vague as for me, she looks ahead with positivity and shows me different perspectives.

Katharina: My supervisor, because of her endless motivation to do new experiments, her leadership, her curiosity. And - very stereotypically - my mum, who always told me that I could do whatever I'd set my mind to.

Daniela: I do not have one role model but many people in my life have left little voices in my head that guide my decisions. I look up to motivated people with high ethical standards and values who are often successful but still down to earth and not arrogant or just fame-driven.

5. Is there any advice you would like to give to your current and future colleagues, any comment you would like to make?

- Care about the team!!
- Trust in the process - things might take longer than you had initially thought they would - but in the end something always works out.
- Everyone seems to be constantly struggling with not being good enough / productive enough / efficient enough. An advice from someone else in the past: find some way to cope with this feeling so that it doesn't become overbearing but make sure not to lose it altogether, because it's a great driving force!
- Trust yourself and your skills, and also trust and listen to your boundaries!

6. Who or what is being or has been ignored and should be better known in the field of photon science?

Photon science is much broader than one might think. One might think about research that is related to generating photons or "taming" them specifically. But the research in photon science also contains all fields that make discoveries using lasers and other light sources in all kinds of frequency ranges in many different materials, from organic tissue to layered magnets. This is not necessarily communicated well.

7. And last, of course, why did you join the SSPh and why should anyone join us?

Katharina: To get connected with scientists in my field of research and to learn new things.

Larissa: It is good to show via a membership that there is a community that is able to organize themselves, collaborate, and represent their interests. A large society ensures that Switzerland stays a good place to conduct research in the field of photon science. Being a member gives you access to insights from the Swiss photon science community that you might have missed otherwise. And it helps you stay up to date with the research going on in many Swiss research groups.

Daniela: I believe that the current developments in HHG and FEL science towards extremely intense X-ray pulses with a level of control that we today only have with optical lasers will push photon science into unknown territory and I am looking forward to be part of that. Photon science is a field with an interesting future and the SSPh brings the Swiss photon scientists together.

Elsa: I joined as a founding member because I liked the idea of being a part of a network that connects scientists around a wide, and yet quite specific, theme. This makes a lot of sense in Switzerland, in particular, where the field of photon science is very active and flourishing. Beyond being a part of this network, being an active member of the SSPh provides a unique access to policy makers and enables us to influence future political and funding decisions and to effectively guide the research directions for this field in the future.